The Electrostatic Deviation of α-Rays from Radio-Tellurium.

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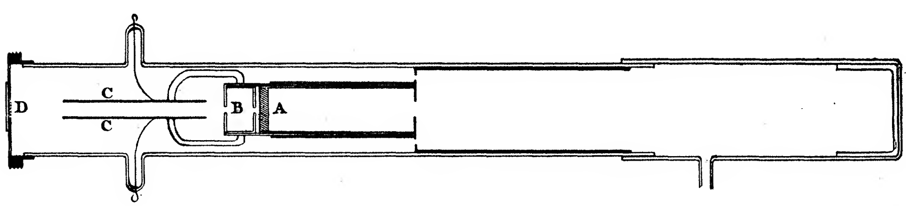
(Communicated by Professor J. J. Thomson, F.R.S. Received June 27,— Read June 28, 1906.)

A determination of the electrostatic deviation of the α-rays from radio-tellurium was suggested to the writer by Professor J. J. Thomson, as a continuation of the work on α-rays done by Professor A. S. Mackenzie.*

The general plan of the work was to let a beam of the rays pass between two charged plates, and then fall upon a glass plate coated with a thin layer of zinc sulphide on the side receiving the radiation. A photographic plate in contact with the other side of this fluorescent screen would be affected by the scintillations and thus mark the position of the beam.

The arrangement of the apparatus used is shown by the diagram. The radiation from the disc at A, passing through the brass slit-tube B, and between the charged plates C, reaches the fluorescent screen D.



A copper disc, coated with radio-tellurium by Sthamer, served as the source of the rays. The slits were 0·2 mm. and 8 mm. apart. Over the outer slit was a sliding magnet (not shown on the diagram), which made it possible to shield the screen from the rays when no field was on. Quartz rods supported the condenser plates, which were of thin steel, 4 cm. long and 1·4 cm. wide. The ends of these plates were 0·6 cm. and 1·5 cm. from the slit-tube and fluorescent screen respectively.

These parts of the apparatus were supported by a long split-ring, which fitted closely in a glass tube 3·3 cm. in diameter. This tube was vertical, the lower end being waxed into a larger tube which contained phosphorous pentoxide, and connected with the mercury pump. The wires from the

* 'Phil. Mag.,' vol. 10, 1905.

Wimshurst machine were soldered to the steel condenser plates, and sealed into glass side tubes. The fluorescent screen was 2 cm. square and 0·35 mm. thick. The coated area was 5 mm. square. This plate was waxed to a brass cap, the latter being waxed to the upper end of the large glass tube, which contained the condenser plates, slit-tube, etc.

The vacuum was as good as could be got with a mercury pump. After the tube was exhausted, the scintillations could be seen with a lens, but they were too few to make eye-measurements possible. Even when using the most sensitive photographic plates, exposures of 40 or 50 hours gave lines which were extremely hazy. Scintillations, and therefore photographs, can be obtained when the rays traverse considerably greater distances than those indicated in the figure; but with narrow slits the time required is very long; with wide slits, the lines are too broad to be of use.

When the rays are allowed to fall directly upon the photographic plate, an impression, of about the same density as that got with a screen, is considerably wider. This effect, due to a screen, suggested using a very thin one over the photographic plate, the combination being sealed into the vacuum tube. A screen 0·1 mm. thick was tried in this way. When no field was on a good plate was obtained, but with the field on the plate invariably fogged, even when the tube was allowed to stand for several days after being pumped out, and when the electrometer had given no evidence that sparking had occurred. Plates showing the double deviation were obtained, but fog rendered them worthless.

It was finally decided to fasten a metal frame to the outside of the brass cap over the upper end of the tube, and to fit photographic plates accurately into this. By choosing plates with smooth edges it thus became possible to measure the distance of a single line from the edge of the photographic plate parallel to it. By using wider slits denser lines were got, and this, it seemed probable, would more than compensate for the errors introduced by having to compare separate plates.

Using this method, several plates have been obtained. Exposures of 60 hours each gave three fairly clear lines. Using these plates, the following measurements were taken for the double deviations.

mm.	mm.
1·20	1·25
1·52	1·35
1·20	1·40

$$2d = 1{\cdot}32 \text{ mm.},$$

or 0·66 mm. for the deviation one way.

The variations in the separate measurements indicate the difficulty in setting on lines which are, at best, extremely hazy.

Calculating $$\int dx \int \mathrm{F}\, dx,^*$$

and using the relation $$\frac{mv^2}{e} = \frac{10^8}{d}\int dx \int \mathrm{F}\, dx,^\dagger$$

we obtain $$\frac{mv^2}{e} = 4{\cdot}64 \times 10^{14}.$$

Since $$\frac{mv}{e} = 3{\cdot}30 \times 10^5,^\ddagger$$

we derive the values—

$$v = 1{\cdot}41 \times 10^9,$$

$$e/m = 4{\cdot}3 \times 10^3 \text{ in electro-magnetic units.}$$

This result is considerably less than the corresponding quantity for radium. The chief source of possible error lies in the difficulty of making accurate settings on a broad hazy line.

I desire to record my thanks to Professor J. J. Thomson for extending to me the privileges of the Cavendish Laboratory, and for advice and suggestions always generously given.

* Maxwell, 'Electricity,' § 202.

† J. J. Thomson, 'Conduction of Electricity through Gases,' § 50.

‡ Mackenzie, *loc. cit.*